Historic England

Preserving archaeological remains
Appendix 5

The reburial of archaeological sites

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Summary

This document is part of a suite of documents about the preservation of archaeological sites. It is a technical appendix to the main text (Preserving archaeological remains. Decision-taking for sites under development) and should be read in conjunction with that document, and where appropriate, the range of planning policy guidance detailed therein.

This appendix covers the processes and materials required for the successful reburial of archaeological sites.

It emphasises the importance of having clear reburial objectives as these define the types of materials used and the design of the reburial stratigraphy. In line with the main text, reburial schemes also require

- an assessment of significance (of the material being buried)
- a condition assessment (of the state of preservation of the materials being buried)
- an assessment of impacts, in this case, re-cast as an identification of threats and consequent assessment of the risks to the reburied material.

Usually, the most appropriate material for reburial is that which has been excavated from the site. If additional material is required it must meet certain criteria. These include capillarity (promoting the free movement of water); chemical compatibility with the buried features (inert or similar pH); the need to be compactable and to maintain intimate physical contact with the buried feature. Reburial materials should cause no mechanical damage to archaeological remains, release no new material into the site and have no significant effect on soil water chemistry.

If imported sand is identified as a new reburial material, specific calculations for the selection of appropriate sand are summarised to help readers correctly identify the most suitable material. Different types and uses for geotextile are also reviewed and advice given about the situations in which geosynthetics might be used.

The text also identifies the range of specialist expertise that may be required to design a reburial regime. Stabilisation of architectural features may be required before reburial and advice is provided on best practice.

Requirements for monitoring of reburied sites are discussed and recommendations are made about appropriate record keeping ensuring archaeologists can access details of past reburial schemes if sites are revisited in the future.

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Additional methodological detail and technical advice is provided in the following appendices:
Appendix 1 – Case Studies
Appendix 2 – Preservation assessment techniques
Appendix 3 – Water environment assessment techniques
Appendix 4 – Water monitoring for archaeological sites

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Introduction

Archaeological sites often need to be reburied as part of a development plan or following on from other interventions which leave unexcavated stratigraphy exposed. This may sometimes take the form of temporary reburial in order to retain the intact portions for the short or medium term, awaiting further excavation. Usually, the aim of most reburial programmes is the long-term preservation of the structures, artefacts, ecofacts and other forms of evidence that the site contains.

The materials used for reburial may need to meet particular geotechnical specifications and, on some sites may also be constrained by aesthetic and economic considerations.

The principal objective for any reburial is ***to create an environment as close as possible to that which existed prior to excavation in order to ensure long-term preservation***. This document outlines the steps to follow when considering a reburial scheme. These are:

- Identify the objectives of reburial,
- Complete a significance assessment; a condition assessment (of the state of preservation); and an identification of threats and risk assessment (of potential risks and their impact).
- Design a reburial scheme in consultation with relevant specialists and stakeholders, as needed.

These are set out in more detail in the following sections. It is also important to remember that reburial is not the end of a process and sites will require some degree of maintenance and monitoring over time, even if that is just visual inspection.

it is worth emphasising that reburial is not the same as backfilling. Reburial is a design process, guided by specific objectives. In contrast, backfilling is the process of putting spoil back into excavated trenches once evaluation or excavation has been completed, where there is usually no expectation that further work will take place or that the site will be preserved. Where fragile, sensitive or significant remains have been identified during excavation and further work or preservation is planned, then the advice and recommendations in the rest of this document should be followed.

1. Objectives of reburial.

As simple as it seems, a key starting point for any reburial scheme is to define the objectives, as these help to define the materials and the reburial design (what to use and how to rebury the area in question).

The duration of reburial and the purpose need to be clear from the start of the process. The duration could be seasonal, short to medium term, or long term. The length of the reburial will influence the choice of materials and may be partly a function of the purpose of reburial.

Likewise, the purpose of reburial is to mitigate and manage the rate of deterioration of archaeological features, through the choice of appropriate materials and reburial design, which is often influenced by duration of burial. Protecting exposed features for a few months from plant growth or erosion from the weather will require a different reburial solution to that needed where a site is buried under a new embankment or protected within a development site.

That is why it is so important that the starting point for a reburial scheme is to define the objectives. As outlined above, most objectives will relate to duration and purpose, but others are likely to be identified during these discussions.

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2 Fundamentals of reburial

There are three criteria that need to be considered in planning any reburial scheme, environmental, functional and programmatic.

2.1 Environmental criteria for reburial

It is important to consider the following issues in designing a reburial scheme

Allowing good water movement – Water moves through most English archaeological sites in response to rainfall or rising or falling ground water levels. The chosen reburial material should not change the way water moves through the archaeological layers and features. See text box on capillarity.

Intimate contact between the fill material and buried feature – To promote water movement and to ensure there are no voids in the reburial stratigraphy (which might also affect the structural stability), the fill material and buried features / deposits should be in intimate contact. If needed (they are mostly not – see section 5.5) geosynthetics should not be placed in direct contact with structural remains.

Fill material chemically and physically compatible with the buried feature – As is noted elsewhere in the document, the material that is most likely to be chemically and physically compatible is the material excavated from the feature in the first place. Where this is not available, investigation of the properties of other materials (using material data sheets or through testing) may need to be carried out.

Thermal protection – The reburial material should be thick enough and of a suitable composition to protect against environmental impacts, from freezing as well as from excess thermal gain.

Inhibiting burrowing mammals – If not carefully designed, reburial materials could become a focus for burrowing animal activity. Methods of control include securely fencing the area around the site until the reburial material is stabilised and ensuring the habitat is maintained in manner which discourages mammal activity (consult an ecological specialist for more information; some general information is given in Historic Scotland 1999). Risks are probably greatest when setts or burrows are disturbed nearby, as generally rabbits and badgers are creatures of habit and faithful to existing burrows / setts which tend to be located at the edge of fields, in hedgerows, banks and other slopes or mounds.

Management of vegetation growth – After reburial, vegetation also needs to be managed to avoid damage to sites from tree and scrub growth and from roots, which may find preferential pathways through loose backfill material.

Site erosion – Soil stabilisation on slopes adjacent to reburied sites (and temporary measures such as netting / matting or other measures that promote vegetation growth) may be needed to reduce soil erosion of reburial materials, as these areas may be more susceptible to erosion until they have stabilised.

TEXT BOX – Capillarity. The placement of reburial materials should aim to recreate the natural capillarity of the soil above the reburied deposits and avoid creating capillary breaks. Water should be able to move up and down the sediment profile (as it had before the excavation took place). If reburial materials prevent the movement of water, it can pool on top of buried surfaces. This may cause leaching and weakening of any constituent mortars. Equally, if material is placed onto a surface which prevents upward water movement above that surface, (for example if you place a thick bed of pea gravel above a mosaic) then any aggressive salts within the underlying soil may crystallise on the surface, leading to mechanical degradation.

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2.2 Functional criteria for reburial

The following aspects may need to be factored into the design of any reburial scheme

Facilitate re-excavation if needed – Materials used to temporarily cover sites (for example between seasonal excavations to make it quicker and easier to start again the next season) need to also satisfy the criteria set out above and below. They should only be used where there is a specific plan (and appropriate funding) in place for subsequent phases of excavation.

Deter theft, vandalism or accidental damage – Theft or vandalism are not common occurrences on archaeological sites in England, but where it isn't possible to secure the perimeter of the site and the risks are deemed to be high, the introduction of ground-level or buried deterrents may be necessary, such as reinforced concrete pads or thick stainless steel mesh. These may degrade and break-down over time so the impact of that deterioration on the buried remains needs to be assessed. Accidental damage should be controlled through mitigation measures identified in the risk assessment.

Require minimal maintenance – Reburial solutions are unlikely to be successful if they require complex maintenance interventions to work. Some upkeep (for example grazing or cutting grassed areas) may be necessary, but most schemes for medium to long-term reburial should be designed to be as passive as possible, requiring only the initial reburial / construction phase and subsequent monitoring visits.

Accommodate (some) activity over the buried feature – After excavation, many sites are required for different uses, from farming, open spaces or are integrated into development sites. The reburial design needs to take these and other future uses into consideration. Sometimes those activities need to be controlled (by protective fencing; site visits; monitoring etc.)

2.3 Programmatic criteria

The duration of reburial will have a big influence on the decisions made. However, given the potential for short term solutions to become long-term conservation problems, it is best practice for any reburial to fully consider all relevant reburial criteria.

Seasonal – When archaeological sites are excavated over multiple seasons, or other intermittent timescales, temporary reburial between excavation periods may be required. Any materials used, such as a geosynthetic to separate the backfill from the unexcavated areas should still be used in accordance with the environmental criteria outlined above (for example, it would still be necessary to cover sensitive areas with an appropriate fill prior to laying down a geosynthetic). Just putting down an impermeable, cheap tarpaulin or geotextile of unknown properties and covering it with a few heavy items is not an adequate strategy.

Short to Medium-term – Sometimes solutions are required for temporary reburial to protect a site while a longer-term plan is devised or funding acquired; this might be for further excavation or incorporation within a construction design for long-term reburial. The potential that plans may change or funding may not be forthcoming should be captured by the risk assessment process; adequate mitigation measures should be considered, for example designing the reburial scheme with a longer-lifespan.

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Long-term – A reburial programme with an intended long duration. This might be "forever" but there may be different timescales which might inform the reburial objectives (for example, reburial until the next time the site is developed). These decisions are informed by other discussions about the management of the site, through the processes set out in the main guidance document (Preserving Archaeological Remains 2016)

*BOX TEXT – **Why does this matter to me?** Some of the recommendations within this document perhaps feel like they are only relevant to sites with structural remains or mosaics. As with all aspects of the approach taken in the Preserving Archaeological Remains guidance (2016) and its appendices, the recommendations outlined are scalable, with the most significant and complex sites requiring more detailed investigation and assessment. In many instances on English archaeological sites, features consist only of ditches and pits, and many finds classes are robust and able to withstand further burial with minimal protection. Nonetheless there may still be unexpected discoveries that require designs to be changed to protect significant remains, and even on the least complex sites, quickly working through the points set out in this document will help ensure long-term preservation of surviving archaeological features.*

2.4 Considering reburial from the start

Reburial can be a complex, expensive and time consuming process, requiring time and input from specialists and the production of a range of assessments. If not properly planned, damage and deterioration can occur while assessments are being undertaken and decisions are being made.

To ensure success, it is good practice for reburial to be considered from the outset of an excavation, during the project planning / design stage. This ensures adequate consideration has been given to soil retention and management (for example the separation of soils based on area of excavation), and for the time and budget for any interim solutions such as temporary reburial or site vegetation management.

As is emphasised throughout this document, the most suitable material for reburial is usually that excavated from the feature being reburied. Not only does this material meet many of the criteria outlined above, it also reduces the cost and need to bring in new materials to site (and the time spent in identifying suitable new materials). However, the use of soil from the site requires planning from the start to separate out materials for reburial.

If, for example you have soil that has been excavated from directly above a mosaic, this will most certainly be the best material to put back on top of the mosaic, so it essential that it is kept separate so that it can be used for reburial. Soil may need to be stored under cover to prevent contamination by new vegetation.

As was noted in the introduction, reburial is different from backfilling - reburial is a design process, guided by specific objectives, in contrast to backfilling which is the process of putting spoil back into robust excavated trenches once evaluation or excavation has been completed. Unless there are features / deposits / finds within an area that are not robust enough to withstand having material placed back on them, then backfilling should take place as per existing good practice. During the excavation, sub-soil and topsoil should have been separated and it is good practice to place the backfill in the reverse order that it came out (ie sub-soil first, topsoil back last). On large development sites, this process will likely be set out in documents such as the project's soil management plan.

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3 Assessment needed for reburial

It is best practice for all reburial schemes to undertake the following assessments, regardless of the size or duration. The detail required will usually depend on the complexity, significance, and size of the site as well as whether the reburial is temporary (short / medium term) or more permanent (long term).

3.1 Assessment of significance

It is important to understand what it is that is being reburied and why it is important. This is achieved through carrying out an assessment of significance. As was indicated in the overarching preserving archaeological remains guidance (Historic England 2016), the approach should follow that set out in Managing Significance in Decision-Taking in the Historic Environment Historic Environment GAP 2 (Historic England 2015). It sets out three aspects of significance assessment that are particularly pertinent to reburial discussions.

Understanding the nature of the significance – What aspects of the site's archaeological remains are important and why? Are they all of the same significance (and by extension, do all require the same approach to reburial and preservation for the future)? Do they retain archaeological interest (the ability for future expert archaeological investigation to reveal more about our past)? Or are they largely of historic or architectural interest (in that most archaeological deposits have been removed and only solid masonry is still present)?

Understanding the extent of significance – What is the geographical extent of the important archaeological remains? Can areas of different significance be defined across the site?

Understanding the level of significance – Within a development / planning context this provides the essential guide to how relevant planning policies may be applied and is intrinsic to decision-taking where there is unavoidable conflict with other planning objectives.

The assessment should highlight where further investigation of the site / archaeological materials is needed to adequately define significance. The assessment will also provide an opportunity to understand whether the reburial of the site will harm the significance of the asset. A useful approach on a complex site is to map areas of relevant significance, to help guide the design of reburial stratigraphy.

3.2 Assessment of condition (state of preservation)

Appendix 2 of the Preserving Archaeological Remains guidance provides advice on preservation assessment techniques (Historic England 2016a). Assessments of the state of preservation of relevant archaeological and environmental materials from deposits within a site are needed to understand how they might be impacted by any reburial proposal.

Many archaeological sites where reburial is recommended contain more substantial structural remains (walls, floors, culverts, hypocaust pilae stacks, mosaics etc.) and these are not covered in Appendix 2. Prior to reburial, the condition of these remains needs to be assessed. It is good practice for this assessment to be carried out by a suitably experienced architectural conservator, conservation architect / surveyor or engineer, as required.

TEXT BOX ***Finding a conservation professional***

Depending on the nature and condition of architectural features to be reburied, different conservation professionals may be required to assess condition, identify threats, assess risks and assist in designing the reburial stratigraphy. See *Where to get advice* below and *How to Find the Right Professional Help* (https://historicengland.org.uk/advice/your-home/maintain-repair/finding-specialist-help/)

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A condition assessment should identify if any features have unstable material that need stabilisation prior to reburial; or where additional protection might be needed during reburial to protect the most fragile remains. It may, on rare occasions be necessary to undertake materials research to understand what structures have been constructed from to ensure that they won't be impacted by the reburial materials.

3.3 Assessment of threats and risk

This assessment should identify existing threats and potential risks to the success of the reburial scheme, their impact on the significance of the remains and any proposed mitigation measures. Completion of this assessment should provide much of the detail needed for reburial design. General threat and risk categories that might occur are provided, but it is important that these are tailored to the specific site by those carrying out the risk assessment.

Environmental threats – water; vegetation; livestock and burrowing animals; erosion.

External human threats (ie those not directly associated with the site or project) – Theft; vandalism; accidental damage from subsequent use (for example agricultural activity; or post-construction maintenance activities as set out in Davis *et al* 2004).

Project development (management) threats – Construction designs change during reburial design / programme; accidental damage from construction activity; permission for further seasonal excavation withdrawn.

Financial threats – lack of funding of reburial; further funding for seasonal excavations unavailable (where only short-term reburial scheme is in place); funding for monitoring unavailable.

Legal threats – legal consequences of the reburial scheme

Materials threats – unavailability of chosen materials; use of substandard materials.

Monitoring threats – people responsible for monitoring leave scheme / site; monitoring equipment damaged / stolen.

An outline threat and risk assessment table is shown below. The details are not filled out as these will be site specific and need to be completed by those proposing / designing / undertaking the reburial scheme. Not all threats or risk categories will be relevant for each site (and could therefore be removed from the table).

When considering the details of any potential risk it is advisable to be as specific as possible, describing and quantifying the activities or events that might create risk, their potential frequency, duration, location or intensity (Ashley-Smith 1999).

The potential impact on the significance of the site being reburied or on specific elements of that site should be identified in the next column. Subsequent columns should be used to capture the likelihood of that impact occurring, the severity of the impact and the overall risk level (ie estimation of risk). The table below is a template of severity and likelihood that uses a five point scale.

The final column should be used to propose mitigation measures that will be or could be put in place to manage the potential risk. Where the estimation of risk (risk level) for any risk category is greater than medium, mitigation measures should be proposed to reduce the level of risk to low / low to medium.

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Threat Category	Detail of any potential risk	Impact on significance	Likelihood of impact	Severity of impact	Risk level	Proposed mitigation measures
Environmental						
Water						
Vegetation						
Livestock/ burrowing animals						
Erosion						
External human						
Theft						
Vandalism						
Accidental damage						
Project management						
etc.						

Table 1. Threat and risk assessment table for site reburial.

Likelihood \ Severity	Negligible	Minor	Moderate	Significant	Severe
Very Likely	Low Med	Medium	Med High	High	High
Likely	Low	Low Med	Medium	Med High	High
Possible	Low	Low Med	Medium	Med High	Med High
Unlikely	Low	Low Med	Low Med	Medium	Med High
Very unlikely	Low	Low	Low Med	Medium	Medium

Figure. Example of a five point risk matrix. Showing likelihood, severity and the risk level.

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4 Producing a reburial design and specification

This section outlines a range of issues that need to be factored into any reburial design. It is important to allow enough time to produce the reburial design and specification documents; these may take as long to produce as the previous excavation process! This is because time is needed for the assessments, including those from relevant specialists (eg architectural conservators) and for stakeholder review of the documentation.

Where it is known that archaeological remains are likely to require reburial before the excavation begins, for example on a research excavation or one designed to investigate the preservation of an existing, known and managed site, it would be good practice for an initial reburial design to be included in the WSI / project design, as many of the aspects covered in this document will already be known. This will ensure that decisions about reburial don't have to take place rapidly at the end of the excavation and that any costs associated with reburial have been allocated from the start.

4.1 Assessment review

It is essential that before undertaking any reburial that the three assessments, outlined in the previous section are completed as these will provide much of the underpinning information needed to plan and design any reburial strategy.

4.2 Stabilisation / repair

One aspect that the condition assessment might identify is the need to carry out remedial stabilisation of walls, surfaces etc., prior to reburial. If mortars are employed in the repair, they need to be compatible with the condition of the feature. Their use may impact the timing of the reburial (see text box below). Depending on the time between excavation and reburial, plant growth may need to be removed from the site or features prior to backfilling. Where these have rooted into structures, careful removal and stabilisation may be needed.

BOX TEXT - ***Mortars for conservation***

Mortars are defined by their ability to set in water, or not. The latter, non-hydraulic or high calcium lime mortar, sets in reaction with carbon dioxide in the air and evaporation of water in the fresh mix. Hydraulic lime mortars set partly by this mechanism and partly by reaction with water. Artificial cement mortars set in reaction with water. Non-hydraulic mortars are relatively weak and highly water permeable, and therefore are very compatible with most historic / ancient remains. However, they set very slowly (over many months) and if buried before a set, the uncarbonated lime will be leached by rain and groundwater, causing failure. A partial hydraulic set can be achieved with the addition of a reactive pozzolan (a mineral aggregate that promotes a hydraulic reaction), or a weaker natural hydraulic lime can be used if deemed appropriate by an architectural conservator. Cement mortars are not suitable for ancient or historic remains, being too strong and impermeable.

4.3 Stabilisation of periphery

In addition to stabilisation of any structural remains, some sites may require additional stabilisation of the surrounding area, either temporarily or for the duration of the reburial. In some instances, part of the stabilisation process may include new drainage, such as geo-drains (Stewart 2016). Materials such as geotextiles / netting etc., may also be required for temporary or permanent slope stabilisation, assisting the growth of vegetation that will eventually retain the soil.

4.4 Landscape cover

Other considerations for land stabilisation will involve the planting of shallow-rooted vegetation that stabilises the reburial fill. It is important that habitats created to stabilise and cover reburial areas are managed and maintained to keep plant growth to appropriate

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heights and to ensure that scrub and trees don't become established. This is because you want to avoid deep root growth over reburial areas, as they are likely to favour the less well-consolidated fill. It is also important to manage these landscape areas to reduce burrowing animal activity. For example, the management of grass length on the site can help discourage rabbit burrowing (Rimmington 2004). Advice from an ecologist will help with identifying the most appropriate planting and maintenance regimes.

On urban sites, landscape cover may take the form of a combination of planting and paving, with due attention paid to the management of surface and subsurface drainage.

4.5 Material requirements

It is important that the right fill materials are selected as the use of poor materials and bad reburial design can ultimately be detrimental to the site. Fill materials need to provide good water capillarity (free movement of ascending and descending moisture, with an appropriate grain size distribution); need to be inert or chemically compatible with the buried features (similar pH); they need to be compactable and provide good continuous physical contact with the buried feature. Soil from the excavation is usually the ideal fill material.

The use of separation membranes should be carefully considered. They can be used to facilitate re-excavation (for seasonal excavations), may be needed for stabilisation (see above), or as a physical separation layer between two fills for engineering purposes (for example to stop the mixing of two different layers of material). Aside from those limited uses they are not normally necessary for a reburial scheme.

Further detail on materials is given in Section 5.

4.6 Reburying waterlogged archaeological sites

These are some of the most complex sites and will require more information to be gathered to inform the reburial design. A hydrogeological assessment may be required to understand the water environment and how any development or land use change with which the excavation and reburial is associated may impact on water levels in the future. It is not the purpose of this appendix to explain the processes needed to understand waterlogged sites or methods for their long-term preservation; that is explained fully in the main document and Appendix 3.

When excavating waterlogged archaeological sites, it is common practice to keep the parts of the site being excavated wet so that archaeological materials don't degrade. It would also be advisable, particularly where it is possible that reburial will take place, that waterlogged organic deposits removed during the excavation are also stored separately and protected from drying out. Having this material available (and still damp) will make it much easier to place reburial fill back onto any fragile and sensitive materials (such as waterlogged wood). It is also likely to return to a waterlogged, anoxic state more quickly once pumping / dewatering processes that are in place to facilitate the excavation cease. For the reasons given elsewhere in this document (see Chapter 5), backfilling waterlogged archaeological deposits with a granular fill could reduce capillarity and impact on the long-term preservation of these deposits.

4.7 Loading and settlement

When archaeological sites are encountered within construction projects and a decision has been taken to retain archaeological remains within or below the development, there are several ways they can be protected and integrated into the final scheme. One option is to create an area of open space or other benign landscaping over the archaeology.

In other instances, the development can be redesigned to bridge over the remains. It may be possible to protect the remains from compression from the additional load of the building

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using ground beams, piling and tensioned concrete slabs which transfer the load away from the archaeology to the adjacent areas.

Where it isn't possible to transfer the load, the developer's engineers will be able to provide an assessment of the settlement that the additional load will cause to the deposits below (ie from a building or embankment). This assessment should identify the amount of settlement and the depths at which the settlement will occur. Decisions on whether the level of settlement will harm the significance of the buried / reburied archaeological remains will be governed by the nature of the remains and the surrounding deposits. Where the archaeological remains are robust (for example walls or most pottery) and settlement in the surrounding deposits is limited, then it is unlikely that the future understanding of the site will be compromised. Where the site contains fragile remains and the predicted settlement is large, reburial in these situations may not be possible and other options (excavation / redesign of the development) may be required.

4.8 Mosaics

Mosaics are relatively uncommon on archaeological sites in England thus when they are discovered they may be of high significance. In the past, their rarity has led people to look for ways to protect them during reburial with large volumes of imported materials and geotextiles. Extensive international research (see Roby 2004 for a summary) has demonstrated that unless there is a clear conservation requirement for additional materials to be used in the reburial of mosaics, the same approach outlined above, of using material excavated from on top of the mosaic, is the best option. Another key aspect to consider when reburying mosaics (and other sensitive remains) is ensuring that there is enough fill to provide 'insulation from extremes of and changes in both temperate and moisture at the surface of the mosaic' (ibid). Few English mosaics are found on raised floors (with heating hypocaust systems below them), but in instances where voids are present beneath the mosaic, the weight of the fill material should also be considered.

Wherever mosaics are exposed, or their discovery anticipated in new excavations (eg a suspected or known Roman site), a conservator with experience in mosaic conservation should be part of the planning and excavation team, and advise on the best approach to reburial (Stewart 2004)

*Box text – **Why mosaics don't normally need a different reburial strategy**. Covering a mosaic with a geotextile and a layer of sand (or another granular fill) can be detrimental. Depending on the specific geotextile, it could act as a barrier to water movement. In extreme cases, mineral precipitates can develop and adhere any geotextile to the surface of the mosaic. Similarly, sand (particularly any sand cover of more than 20-30mm) is also likely to reduce capillarity if not well-graded. This can result in water pooling on the surface of the mosaic, which can lead to a range of impacts. Where soluble salts are present in deposits below or in the mosaic, the movement of water to the surface of the mosaic can cause crystallisation of salts. Reburying with material from the excavation (sieved to remove any large stones / CBM) removes these problems as water can move freely up and down the soil profile, and any salt precipitation is likely to take place in the deposits above, rather than on the surface of the mosaic (Podany et al. 1994)*

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4.9 Maintenance and monitoring

Most reburied sites will require some form of maintenance and monitoring, even if that is just grazing of grass and occasional visual inspection. The aim of the monitoring is to ensure that fill materials are continuing to provide adequate protection to the reburied remains and that the site isn't subject to harmful erosion, vegetation growth or unacceptable human activity.

Maintenance and monitoring will require staffing and funding. The duration needs to be discussed and agreed with relevant stakeholders. Maintenance and monitoring proposals should be included within the project documentation (see below) and where necessary secured through management agreements.

Undoubtedly the simpler the maintenance and monitoring regime is, the greater the chance of it succeeding. Where a reburial strategy requires an ongoing commitment to significant levels of intervention, there are greater risks that the reburial scheme will fail (Demas 2004). Where technically feasible, these risks should be identified in the risk assessment process and lead to the development of a more manageable reburial strategy.

4.10 Documentation

The precise detail of the documents required is not given in this guidance as they will vary depending on the significance and scale of the archaeological site / project / development. For sites within the planning system, a local authority planning archaeologist may request a Written Scheme of Investigation (WSI) to set out the reburial processes, or a method statement to be appended to an agreed WSI. Regardless of scale and type of archaeological site or how it is funded (commercial development or community research excavation for example), reburial design and detailed specification documents should be still produced. Where reburial schemes are approved as part of the planning process, it may be useful to include the assessments of significance, condition and risk as part of that documentation. A reburial checklist is included in Chapter 6 to provide prompts for the information needed prior to the initiation of a site reburial.

It is essential that relevant stakeholders are involved in the development of these documents. Stakeholders are likely to include project funders, site owners, the archaeologists who have excavated the site, archaeologists required to approve any reburial proposals (such as Historic England Inspectors of Ancient Monuments if the site is a Scheduled monument or Local Authority Archaeologists for sites that come under their purview), specialists (such as conservation engineers / conservators), engineers, consultants and project managers (where the reburial is being delivered as part of a development). The landowner / site owner is a critical stakeholder because after everyone else has 'left the site', the long-term management of the site is ultimately going to be their responsibility.

On large development schemes, the process of designing and implementing a reburial scheme may be complex. There might be quite a long time between archaeological excavation and reburial, and when any subsequent construction activity takes place in and around the area. It is also possible that because of contractual arrangements, different contractors may take responsibility for the area in subsequent phases of work. It is vital that during this time the site isn't accidentally damaged. Protective fencing and signage can reduce these risks, as can the inclusion of the reburial site in relevant project documentation.

Reburied / remaining archaeological features (or human remains) on a construction site come under the category of "residual risk" for the person(s) inheriting the site and there is a duty of care to inform the client and any subsequent contractors or site owner occupiers of any residual risks which may be relevant to future site use, maintenance or modification. Possible locations for this to be recorded include:

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- Health and Safety file
- ITPS (Inspection and Test Plans) and relevant quality documentation relating to the site
- Any information relevant to temporary works which are being handed over if the preservation of the archaeological site or remains has required a temporary structure to protect it (this might be a slab or gabion wall for example which may be classed as temporary works where it has a temporary use life and requires inspection)
- Any other handover and completion documentation (including GIS schema, photographic archive etc.)

Information to be included in any ITP, quality and handover documentation relating to archaeological features should include

- Extent (m) of area of buried remains
- NGR coordinates
- Any buffer zone and its extent (m)
- Depth of buried remains BGL (AOD)
- Type of buried remains (human remains, structural remains, palaeochannels etc.)
- Whether or not the buried remains are sensitive to activities such as compaction, dewatering etc.
- Any stabilisation needed or repair carried out
- Material used for reburial (including data sheets and test reports) and stratigraphy design (rationale)
- Reburial process

In addition to providing the landowner / site owner with the final reburial design and specification, these documents should also be deposited with the local Historic Environment Record so that they are available in case further development, land use change or excavation takes place in the future. They also provide an important record of the decisions made about the reburial should any aspect of the scheme fail and need remedial action to be taken.

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5 Reburial materials and their properties

As is emphasised above, the choice of fill materials for any reburial scheme is critical. They need to be:

- inert or chemically compatible with the buried features (similar pH)
- compactable and provide good continuous physical contact with the buried feature

It is also likely that for most sites, fill materials will need to provide good capillarity (free movement of ascending and descending moisture).

Soil from the excavation is usually the ideal fill material.

5.1 Existing spoil from the site

In most circumstances, the existing spoil from an excavated site must be the first choice for reburial of that site. Nothing else can be specified which will so effectively minimises new taphonomic impacts on the surviving archaeological remains.

Some spoil management may be needed to ensure that it is usable, for example sieving to remove large or sharp stones. The nature of the remains being reburied will ultimately be a guide to the extent of sieving and mesh size requirements. Spoil should be placed and compacted by hand over sensitive remains, with further material back-tipped or applied carefully from a digger bucket once a sufficient depth of spoil had been hand-placed to protect the remains. It may be prudent to place the reburial material and leave it for a short period of time to compact and consolidate under its own weight prior to returning and topping up any areas to bring fill up to the final levels. Alternatively, a higher level of fill can be placed over the reburied site, to allow for eventual settlement to an acceptable level.

The use of sandbags, for example to support features, should be avoided, as it is hard to place these without creating voids and difficult therefore to ensure the backfill is properly compacted. This can lead to voids and over time, slumping. Also, plastic sandbags impede the free transmission of moisture through the reburial profile.

It is good site practice to separate out topsoil and subsoil / archaeological deposits, and on many larger projects, soil handling recommendations will be covered by the site soil management plan. Soil for reburial needs to be free from upper organic humus-rich topsoil material. Where it is possible, and as soon as it is proposed that site remains may be reburied, soil from features being excavated should be separated and stored for later reuse. Covering the soil will help it retain moisture and reduce plant growth through wind-borne seeds.

There are sites where space constraints have traditionally led to soil being removed from site and deposited elsewhere. It is recognised that for these sites, retaining that spoil for subsequent reburial on site, or even off-site, will represent an additional challenge. However, this will need to be balanced with the subsequent cost and effort required to source an appropriate replacement fill material for reburial that can satisfy the criteria within the document.

5.2 Other reburial materials

Where there is insufficient existing excavated material to complete the reburial; it is contaminated and must be replaced; or fill materials must meet specific geotechnical requirements, other reburial materials will need to be used. The properties of any material used need to be assessed. Most material suppliers will have data sheets for their products which should be consulted for precise details. If no such detailed information exists for specific products, they should not be used.

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The location within the reburial scheme where the fill materials are used also needs to be considered. Will the material be used for the primary fill in direct contact with the archaeological remains or is it providing secondary fill further up the sediment sequence?

5.3 Sand

The mechanical properties of sand make it suitable for reburial, and it is frequently the cheapest readily available material in most localities. However, poorly graded sand, or sand used in too great depths can impact on water capillarity and may not be suitable in particular circumstances. It can result in water ponding on reburied structural surfaces.

Not all sands are suitable for reburial projects. They need to be high silica, low iron sands free of soluble salts and organic material, that are chemically inert (at least over human timescales). Ideally they will be well-graded to promote capillary transmission of moisture. It is beneficial to source the sand from as close a location as possible, as transport costs are a large part of the bill.

A detailed methodology for characterising and selecting sands for reburial can be found in Annex 1. Sometimes a sand is available on-site or from a nearby location which doesn't meet these criteria but that matches the site geology and geochemistry. Assessment of the condition and state of preservation of the remains to be reburied will indicate whether it would be suitable as a fill material.

From a chemical perspective, an inert sand will not change the chemical composition (the solute properties) of the pore water in the deposits. While this is usually key in the selection of a fill material, it does mean that (unlike a soil for example) it cannot provide any buffer against unfavourable qualities, such as agricultural chemicals in surface run-off.

5.4 Gravel and other forms of ballast

Siliceous gravels can be a useful substitute for mass volume filling, where the existing site material is not present, where capillary issues are not a concern, and where protection of archaeological remains is not needed or has already been provided by another fill material. Gravel is never appropriate in direct contact with a buried feature as this can create water ponding on top of the buried feature that may cause long term degradation or can lead to excessive point loading due to the larger particle size.

An advantage of rounded flint gravels (such as pea shingle) is that they are free-running and therefore do not need compression. If used, it is important to ensure that these gravels are composed of silica and not from other geological sources (such as limestone), otherwise they could lead to a chemical change in the deposits. Gravels should be washed, clean, and should not contain other adhering particles.

There may be circumstances where other fill materials are needed for some reason or are cheaply available. It may be possible, for example, to use some types of stone chippings as part of a reburial programme, after careful consideration of the mechanical and hydrological effects. In such circumstances, a chemical analysis of the proposed material may be needed to compare with the site's environmental conditions, for example the deposit pH. Local geological advice should be sought, and the suitability weighed up on a case-by-case basis.

5.5 Geosynthetics

There is a wide range of sheet and fabric geosynthetic materials, such as geotextiles, geogrids, and geomembranes. The most commonly used are geotextiles; these are usually permeable, to variable degrees (but some are definitely not), meshes or fabrics made from polypropylene or polyester which can last for centuries in the ground. They are designed to separate, protect and reinforce layers, filter materials or assist drainage in many

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geotechnical and construction situations (see Kavazanjian 2004). The numerous types available have a range of strengths and permeabilities.

There has been an increasing, and almost default usage of geosynthetics in the reburial of archaeological remains either as a horizon marker or to facilitate re-excavation. Although these have been applied with the best intentions, they are not, in practice usually required and can at times cause damage to the assets they are installed to protect. They are all derived from fossil fuels and have an environmental (and financial) cost, so are not environmentally sustainable.

If used, their installation needs to be justified and based on a full understanding of their material properties. Manufacturers technical datasheets should be consulted in advance of specification and purchase. It is particularly important that they provide good liquid and water vapour permeability (measured in litres per metre). Materials without good technical data should never be used.

Geosynthetics, such as geotextiles vary hugely and the use of the wrong one could be deleterious to the reburial environment. They should never be placed in direct contact with archaeological or architectural features (or shoved into holes), as this can create voids between the archaeological remains and the fill material; promote root growth below the geotextile; or cause mineral precipitation that adheres the geotextile to the feature (Neguer 2004).

With appropriate archaeological recording (site survey ie levels, photographs, plans / sections etc.) it should not be necessary to leave a marker layer for future archaeologists. After all, there are many thousands of archaeological sites recorded on Historic Environment Records, and we don't usually mark their location on the ground in any way. When we re-excavate trenches from previous excavations, as archaeologists we are, more often than not, still able to find the trenches of these past investigations.

Where protection, for example from accidental damage is required, fencing, or enhanced systems of working (ie permit to dig) will be a more effective way to manage that risk, than the hope that someone digging a hole will notice a marker layer and stop digging.

If geotextiles must be used for short / medium term reburial, the reburial design should consider the reuse, resale or recycling of these materials. However, as noted above, short-term options have the habit of becoming long-term solutions through inertia and funding difficulties.

It follows from the above discussion that there are limited instances where it would be considered good practice to use a geosynthetic as part of a reburial design. These might include:

To separate different reburial / construction fills – Geotechnical engineers will sometimes use geotextiles to prevent different construction materials from becoming mixed, as this can impact the stability of the structure they are constructing.

As load-spreading layer - All geosynthetics will have a slight load-spreading effect. Laying a geotextile down on a subsoil or topsoil surface prior to adding further fill (for example as part of the construction of an embankment) would help to spread the load of the initial weight of the embankment material. Their use for this should be fully justified and not just a default option of "lay geotextile, then sand, then gravel", without understanding what each of these materials individually and collectively will contribute to the protection of the buried archaeological remains.

More rigid geosynthetics, such as geogrids can spread loads without the need for adding a lot of extra material, and can be particularly useful in areas where ground levels cannot be

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raised significantly (as this might have a visual impact, for example) and where the load being carried can be supported by the geogrid (as long as it is installed in line with the manufacture's specification). They may also be used to spread construction loads in larger development schemes.

To inhibit root damage / burrowing – Geotextiles can play a part in managing post-reburial impacts from tree roots or animal activity on site, but careful selection is needed as not all tree root control barrier geotextiles are permeable. If used, they shouldn't be placed close to the archaeological remains, and their use should be discussed with an ecologist or similar specialist to consider whether other options are available. A geotextile shouldn't be used as a substitute for designing and implementing an effective monitoring and maintenance programme for landscape works.

Soil stabilisation / erosion control – A range of organic materials and geosynthetics are available for soil stabilisation and erosion control (erosion mats) that might be required to help ensure that reburied materials stay in place on sites with slopes or where erosion from wind, surface water or waves are a concern (Stewart 2016). These would usually be applied at or just below the ground surface (rather than close to the archaeological remains) but it is still important that their permeability is assessed so that they don't have a negative impact on the burial environment.

5.6 Human resources

In many cases, the placement of the burial material will involve some element of manual handling, particularly at the initial stages of reburial, when protecting fragile remains. This work is time-consuming and can be labour-intensive. As with other site activities, it needs to be appropriately planned into the site work. Health and safety risks need to be properly and regularly reviewed; at the end of a field season of excavation for example, tired staff maybe more susceptible to slips, trips, falls and other manual handling accidents.

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6 Reburial Checklist

	✓
Have you identified the objectives of reburial?	
What are they – summary of objectives (ie why are you reburying / backfilling and what is the purpose of the reburial process):	
Have you carried out an assessment of significance?	
Is the significance uniform across the site or are there areas which contribute to a greater or lesser degree? Summarise the key aspects of the archaeology that contribute to the significance of the site:	
Have you carried out a condition assessment?	
What are the main vulnerabilities of the site and its materials proposed for reburial? Do any areas / features require stabilisation prior to reburial?	
Have you carried out a threat and risk assessment?	
What are the main risks and how can they be mitigated?	
Have you produced a reburial design?	
What are the main environmental criteria the scheme is designed to control?	
What are the key functional criteria that the design reflects?	
What programmatic criteria have influenced the design?	
Summarise and justify the reburial design (stratigraphy, depth) and materials	
Have you consulted relevant stakeholders (including the landowner / manager) during the design phase?	
Set out the steps you have taken to ensure that all stakeholders are aware of the reburial scheme and have agreed the design. Who are they?	
Do you have a maintenance and monitoring programme?	
Summarise the main components of the programme here and the measures in place to ensure it will remain successful, with responsibilities of specific stakeholders:	
Will the design documentation be stored so that it is accessible in the future?	
Where will it be stored? How have any responsibilities been passed on from the project to the landowner, or from one construction team to another?	

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In addition to the references above, this guidance is based on the experience of its authors in discussing and designing reburial schemes, and informed by international research on reburial, the work of countless staff at the Getty Institute and subject-specific meetings, such as Reburial of archaeological sites: A colloquium organized by the Getty Conservation Institute, the National Park Service (Intermountain Region) and ICCROM Santa Fe, New Mexico, 17–21 March 2003. Papers from this colloquium were published in Conservation and Management of Archaeological Sites, Volume 6, issues 3 & 4 (2004). Those such as Demas (2004), Neguer (2004), Roby (2004) and Stewart (2004) can be seen as the starting point for many of the overarching themes covered in this document.

The Getty Conservation Institute has also trained conservation technicians in the treatment and maintenance of mosaics on archaeological sites in North Africa and the Middle East, in cooperation with national authorities in the region. The lecture on reburial of mosaics is available at:
www.getty.edu/conservation/publications_resources/teaching/pdf/mosaics_conservation/mosaics_reburial_july2021.pdf

Additionally, The Getty Conservation Institute has published an annotated bibliography on Conservation and Management of Archaeological Sites which includes a section on the reburial of archaeological remains
https://www.getty.edu/conservation/publications_resources/pdf_publications/conserv_mngmnt_arch_sites_biblio.html

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8 Where to get advice

8.1 Historic England

The first point of contact within Historic England for general archaeological science enquiries, including those relating to the reburial of archaeological remains, should be the Historic England science advisors, who can provide independent, non-commercial advice. They are based in the Historic England local offices. For contact details see http://www.HistoricEngland.org.uk/scienceadvice

8.2 Finding a conservation professional

Building Conservation Directory
www.buildingconservation.com

ICON Conservation Register
www.conservationregister.com

Register of Architects Accredited in Building Conservation (AABC)
www.aabc-register.co.uk

The Royal Institute of British Architects (RIBA) Conservation Register
www.architecture.com/working-with-an-architect/conservation-register

Royal Institution of Chartered Surveyors (RICS)
www.rics.org/surveyor-careers/career-development/accreditations/building-conservation-accreditation

8.3 Finding an accredited material testing laboratory

United Kingdom Accreditation Service
www.ukas.com/

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9 Case studies

A series of case studies are being developed for the final guidance document to illustrate the points made in this document.

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Annex 1 – Finding a suitable sand for reburial

A full discussion of sand characteristics and sourcing can be found in Canti and Davis (1999). A summary selection procedure adapted from that paper is given here.

- Source as locally as possible; transport costs are a large part of the final bill.
- Sands need to be pale (ideally yellow to white) and non-calcareous. The best range of Munsell Hues is 7·5 YR, 10 YR and 2·5 Y to ensure low iron content (which reduces the risk of staining); and the Values should be 6, 7 or 8 to help ensure low organic matter. These are partly characteristics of the geological deposits from which the sands are derived, details of which the quarry should be able to supply.
- Sands need to be relatively low in clay, because higher clay content impedes drainage. The clay content can be a function of geology but is also artificially achieved by many quarries through washing.

Once possible sands are established as passing these general suitability tests, more detailed examination of their characteristics needs to be carried out. Most quarries will provide accredited chemical data from X-ray fluorescence (XRF) tests, loss-on-ignition (LOI - which determines the amount of organic content) and particle size (often called ‘‘mechanical’’) analyses. Alternatively, samples can be requested and these three tests then commissioned from commercial laboratories (see section 8 *Where to get advice*).

Once the data are available, the following selection procedures should be carried out

- Particle size data should show 98% or more finer than 2 mm and 5% or less finer than 63 µm.
- LOI should be 2% or less, as organic matter increases chemical and biological activity.
- The LOI percentage and any other tiny values (labelled ‘‘trace’’ or “less than 1%”) can now be ignored and the other percentages recalculated.
- These modified oxide percentage values should be put into three groups
    - Inert oxides: SiO_2, Al_2O_3, TiO_2, ZrO_2, V_2O_5
    - Reactive oxides: CaO, Na_2O, MgO, K_2O, P_2O_5, BaO, SrO, ZnO
    - Staining oxides: Fe_2O_3, Mn_3O_4, Cr_2O_3.

The totals of these groups should be: staining oxides 1% or less, and reactive oxides 1.5% or less, leading to an inert oxides total of 97.5% or more. This can be visualised as a ternary diagram on which the suggested oxide group limits are represented as an area of acceptability (Figure 1).

Four sand samples from the original study are shown in Table 1. Sample R1 and R2 would pass the tests described above, as they contain more than 97.5% inert oxides, and very low percentages of reactive or staining oxides. Sand R8 contains higher levels of calcium oxide (CaO) and potassium oxide (K_2O) than is appropriate in a sand used for reburial (and also a higher LOI result than is acceptable too). Sand R9 has a high level of iron oxide (Fe_2O_3) which is also higher than the levels for staining oxides suggested above.

[Figure 1]

[Table 1]

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